range, *R. baileyi* inhabits isolated rock outcrops. A means by which gene flow might be maintained in this species is being sought.

In addition, a member of the genus *Orymaeus* in this family was found in the southern part of Sonora, a new record for this state.

INFLUENCE OF OPTIC TENTACULAR PRINCIPLE IN THE BIOSYNTHESIS OF STEROIDS IN THE OVOTESTIS OF *CRYPTOZONA BELANGERI* (DESHAYES) (PULMONATA;GASTROPODS). S. Rajasekaran, V. Srlramulu and **T. Srldharan,** Department of Zoology, Annamalai University, Annamalainagar, India.

Isoprenoid lipids, as components of hormones, are indispensable in the physiology of reproduction, since they regulate the functional differentiation of the reproductive organs during reproduction. Progesterone, testosterone and estrogen are groups of 21, 19, and 18 isoprenoid lipids which play an important role in regulating the reproductive activity in animals. The occurrence of the intermediary structure 17-b hydroxy testosterone in the pathway of conversion of estrogen from testosterone has also been studied, along with the progesterone, testosterone and estrogen in the gonad of the terrestrial pulmonate gastropod mollusc *Cryptozona belangeri* (Deshayes) using low frequency H'FT NMR Spectrometer.

The experimental snail is protandrous hermaphrodite where the male reproductive organs are activated first after the differentiation of the gonad towards the male phase (spermatogenesis) followed by the female phase (oogenesis). The spectrographic pictures showed that the male phase gonad has a higher level of testosterone, the estrogen level being low and while the female phase gonad exhibited a higher level of estrogen together with an increased level of 17-b hydroxy testosterone. The spectrographs of the optic tentaculamised male phase snail analysed at an interval of 10 days up to 30 days showed a sharp fall in the titre of testosterone level, but recorded a characteristic increase in the level of estrogen. The 17-b hydroxy testosterone signalled an initial increase followed by a fall within 20 days after tenetaculectomy paving the way for the enhanced biosynthesis of estrogen.

In the present investigation, it is inferred that the steroid hormones are synthesised in the ovotestis of the snail and the hormones elaborated characterize the specific sex in the hermaphroditic snail, either to conform to male or female phase. The results of the optic-tentaculamised snails illustrate the prevalence of relationship of optic tentacle with the gonad. Switching over from one phase to the other phase depends on the optic tentacular principle which plays a decisive role in modulating the biosynthesis of specific steroids, either androgens or estrogens, by gonad characterising the male or female phase of the snail.

RADULA DYNAMICS: ANALYSIS OF MOVEMENT PATTERNS AND SUBSTRATE INTERACTIONS. Carole S. Hickman, Department of Paleontology, University of California, Berkeley.

The morphological complexity of the molluscan radula makes the structure a rich source of characters for taxonomic differentiation and analysis of phylogenetic relationships. The radula is also a source of "unconventional" characters that are derived not from static morphology but from analysis of radular function. Changes in spatial relationships of teeth, sequences of individual tooth-tooth interactions and tooth-substrate interactions, paths and rates of tooth movement, as well as patterns of tooth row movements and interactions are more variable than the static morphology of the extracted radula and its individual teeth.

Two techniques for defining dynamic characters are motion analysis of filmed feeding strokes and analysis of feeding tracks on artificial and natural surfaces.

Frame-by-frame analysis of a single feeding stroke of a duration of one second and filmed at 64 frames/second provides 64 static images of successive positions of tooth rows and individual teeth. Traces of the motion of rows and individual teeth relative to fixed points on the substrate yield patterns that can be described, illustrated, and quantified in the same ways that conventional morphology is treated. This method of analysis is restricted to animals that can be induced to protract and retract the radula on a transparent surface for filming. Feeding track analysis can be used alone or in conjunction with dynamic analysis. The traces of teeth on artificial and natural substrates have their own static morphology and also can be described, illustrated, and quantified in the same manner as conventional characters. If relationships can be established between individual incisions and the teeth that produced them and if the temporal sequence of incisions can be established, then several higher levels of pattern are available for use as characters. The four temporally and spatially parallel gouges of a patellacean limpet provide a striking contrast to sets of spatially parallel but temporally sequential gouges of a trochacean gastropod. When the traces are oriented relative to a morphological constant (the longitudinal axis of the radula) the difference is even more striking because the longitudinal axes of the gouge sets are 90 apart.

Traditional systematics avoids the use of functional and behavioral characters on the grounds that common function and behavior frequently are the result of convergence. However, if function is precisely defined and expressed in terms that are essentially morphological, it extends the definition of form and provides a basis for unmasking convergence in static morphology.

FUNCTIONAL MORPHOLOGY OF SOME CHITONID RADULAE (POLYPLACOPHORA: CHITONIDAE). Robert C. Bullock, Department of Zoology, University of Rhode Island, Kingston.

The radula of the polyplacophoran family Chitonidae consists of 17 highly modified teeth per row. There is much within row and within column integration of tooth function and the rows are difficult to discern due to their offset nature. Each centro-lateral of *Chiton* and *Acanthopleura* has a single cusp with a small pad on the distal lateral edge that articulates with the shaft of the major lateral when the ribbon is curled. The use of magnetite on the denticle cap of the major lateral is usually conserved and its presence on the back surface of

the self-sharpening cusp is limited to the outer margin and a pronounced central tab that possibly protects the cap during withdrawal. When the ribbon is curled the wings of opposing major laterals meet and prevent the denticle caps from abrading each other. The wings may also aid in the collection of food particles.

Each major lateral articulates with at least two inner small laterals. The outer small lateral helps to support the major uncinus which often has an L-shaped base. The inner marginal also supports the major uncinus and directs it inward during the curled position such that the distal blade interleaves two denticle caps. The major uncinus shields the unprotected back surface of a denticle cap from contact with the heavily mineralized portion of the next denticle cap in the column, but it also appears to serve as a sweeping tooth to collect food particles.

Near the anterior end the radula ribbon expands laterally and the denticle caps are directed inward. When *A. granulata* feeds 3-6 pairs of major laterals converge medially. The conspicuous grazing marks are roughly perpendicular to the longitudinal axis of the animal and they do not meet at the center. This indicates that this species probably rasps small particles from the substrate, but it is incapable of tearing away larger pieces.

RADULAR EVOLUTION IN THE PATELLOGASTROPODA. David R. Lindberg, Museum of Paleontology, University of California, Berkeley, California.

The Patellogastropoda (families Patellidae, Acmaeidae and Lepetidae) have a unique radula morphology among the Gastropoda. The bending plane over the odontophore is flat rather than curved as in other gastropod taxa and thus the radular teeth interact with the substrate like a rasp rather than being splayed against it. The lateral teeth are impregnated with ferrous oxides, and are positioned in either a stepped arrangement (the inner laterals are in a row) or inverted V arrangement (the lateral teeth diverge posteriorly). All three families have similar lateral tooth modifications for particular food types. Modifications for coralline algae, fleshy marine plants, and high intertidal flora are remarkably similar between families. Basal plate morphology becomes more complex in the derived taxa (*Patella* ◗ *Cellana* ◗ acmaeids). Evolutionary trends in the patellogastropod radula include: (1) the derivation of the inverted V configuration from the stepped configuration, (2) the reduction of tooth number, (3) the development of basal plates, and (4) the modification of lateral teeth for specific habitats. Simple changes in radular development appear to be responsible for the various radular configurations in the patellogastropods. The developmental events include the failure of odontoblasts to divide and the fusion of odontoblasts. Teratological radulae suggest that these events occur in three distinct tooth fields. The bending plane of the radula over the odontophore, the stepped radular configuration, and the presence of ferrous oxides in the lateral teeth are also present in polyplacophoran and monoplacophoran taxa.

AQUATIC MOLLUSCA OF THE ARKANSAS RIVER BASIN. Mark E. Gordon, Department of Zoology, University of Arkansas, Fayetteville.

The Arkansas River drainage with a 416,071 km^2 watershed is a major tributary system within the Interior Basin. Arising from the Continental Divide in Colorado, the Arkansas River flows 2333 km and descends 4366 m through several geomorphic provinces to its confluence with the Mississippi River. The aquatic malacofauna of the Arkansas basin has been assessed from critical review of published surveys, examination of museum vouchers, and personal collecting. One hundred three species have been identified: 37 gastropods, 50 unionaceans, and 16 sphaeriaceans. Six species have been introduced and another five unionaceans may exist in the faunally little-known portion within the Mississippi Alluvial Plain.

While the fauna is primarily composed of wide-spread Interior Basin species, high species richness has developed due to interactions between diverse physical conditions and regional endemism. Rocky Mountains habitats are dominated by rather ubiquitous, pioneering pulmonates and pisidiids. Similar faunal composition extends across the xeric High Plains. Influx of species, including unionaceans, occurs as the river flows into the more mesic Central Lowlands. Species richness is maximized near the junction of this province and the Interior Highlands. In this area, environmental parameters are most diverse and distributions of northern and southern Interior Basin species and Interior Highlands endemics are sympatric. As a result, several northern species reflect disjunct distributions relative to the rest of their range. While stream capture has been speculated as the explanation for such, these patterns are probably artifacts of Pleistocene biogeography. Post-Pleistocene climates restricted these northern species to upper portions of the drainage while southern species were able to invade Central Lowlands habitats via the conduit through the Interior Highlands represented by the low-gradient Arkansas River. Such southern recruitment may have been enhanced by the former channel of the extreme lower Arkansas which is presently occupied by Bayou Bartholemew.

DIURNAL AND SEASONAL VARIATION OF TERTIARY DIGESTIVE TUBULE MORPHOLOGY IN *CORBICULA FLUMINEA* (MÜLLER). Kashane Chalermwat, Department of Biological Sciences, University of Southern Mississippi, Hattiesburg.

Digestive tubule morphology during 24-hour periods in *Corbicula fluminea* show that animals maintained and sampled in the laboratory and those that were field sampled show different tubule appearance. "Starved" laboratory animals showed more random tubule morphology. "Fed" laboratory animals showed dominance of tubules in disintegrating and absorptive stages. Field sampled animals also show dominance of disintegrating and absorptive stages. Tubule morphology of bivalves in field samples and "fed" laboratory animals throughout 24-hour periods suggest continuous feeding. There is however, a notable difference in digestive tubule appearance between field and "fed" laboratory animals. Within digestive cell cytoplasm of field animals were found varying degrees of excretory vacuole formation. These